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FUEL CELL
[NENRYO DENCHI]

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1. Title of the Invention

Fuel cell

2. Claims

(1) A fuel cell, which generates power by reacting fuel and an oxidant, said fuel cell comprising of a water absorption layer, which is made of a hydrophilic material and is arranged in at least a part of a surface of an oxidant feeding groove along a longitudinal direction of said groove, said groove facing an air electrode of a separator that functions as paths of fuel and oxidant and a power collection member; and a water trapping member, which is made of a hydrophilic material and has paths to flow said oxidant on the end face that faces oxidant feeding means of said separator, wherein said water absorption layer and said water trapping member are connected to each other.

(2) The fuel cell according to claim 1, wherein said water trapping member is a sheet member that is essentially made of a hydrophilic material and has a hole to pass said oxidant.

(3) The fuel cell according to claim 2, wherein said water trapping member is a mesh-like member that is essentially

made of a hydrophilic material and has a pitch smaller than the width of said oxidant feeding groove.

(4) The fuel cell according to claim 1, wherein said water trapping member that is made of a hydrophilic material is adhered at the end face that faces said oxidant feeding means of said separator while opening the end section of said oxidant feeding groove, and said water trapping member is extended and adhered up to a part of respective surfaces that faces a fuel electrode and said air electrode of said separator.

(5) The fuel cell according to claim 4, wherein said hydrophilic material of said water trapping member is powder.

3. Detailed Description of the Invention

[Applicable Industrial Field]

The present invention relates to a configuration of a fuel cell, and specially relates to a device of discharging water generated at an air electrode of a fuel cell.

[Conventional Technique]

In a conventional configuration of a common fuel cell, a fuel electrode supporting a catalyst, an air electrode supporting the same catalyst, an electrolyte film between the electrodes, and a separator that has paths to supply fuel and an oxidant to the electrodes are overlaid.

Furthermore, the cell is configured by overlaying a plurality of the unit cells and disposing a manifold for feeding the fuel and the oxidant.

However, in the fuel cell of this configuration, a material of the separator is usually carbon, graphite, or other material, and has water repellency. Therefore, although water is produced at the air electrode as a result of the reaction, the water is condensed in a separator and forms water drops and clogs the oxidant's path. Accordingly, there are concerns of worsened flow of the oxidant, inhibition of supply of new oxidant and also impaired performance of the cell by decrease of the reaction area.

In order to solve the problem, as described in Unexamined Japanese Patent Application Publication S63-110555, there is a proposal of providing a hydrophilic fiber structure between the air electrode and the separator, but the structure is complicated and large, so that there is a problem of being less effective at the horizontal position.

[Problems to be Solved by the Invention]

An objective of the invention is to provide a fuel cell that can improve the drawbacks in the conventional

techniques, rapidly and efficiently discharge produced water, and thereby improves the efficiency of the fuel cell.

[Means to Solve the Problems]

In the present invention is an invention, the following technical configuration is employed in order to attain the above object.

More specifically, a fuel cell that generates power by reacting fuel and an oxidant includes a water absorption layer, which is made of a hydrophilic material and is arranged in at least a part of a surface of an oxidant feeding groove along a longitudinal direction of the groove. Here, the groove faces an air electrode of a separator that functions as paths for the fuel and the oxidant and a power collection material. In addition, the fuel cell includes a water trapping member, which is made of a hydrophilic material and has paths to flow the oxidant at the end face that faces an oxidant feeding means of the separator. The water absorption layer and the water trapping member are connected to each other.

Furthermore, in the fuel cell of the invention, the water collection member to be disposed at an end surface that faces an oxidant feeding means of the separator is formed as a sheet member having holes, which is made of something like a mesh, to flow the oxidant. As a special

case, the water trapping member that is made of a hydrophilic material is adhered on an end surface that faces said oxidant feeding means of the separator while opening the end section of the oxidant feeding groove, and the water trapping member is extended and adhered up to a part of respective surfaces that faces a fuel electrode and the air electrode of the separator.

[Working Principle and Effects of the Invention]

In this invention, with the above-described configuration, water produced at the air electrode is condensed, but immediately absorbed by a hydrophilic material provided on a groove surface in the oxidant feeding groove [11], conveyed to the end by capillary phenomenon, collected at lower portion of the manifold via the water trapping member, and then discharged to the outside by a drain. Therefore, the groove will not be clogged by retention of water.

In addition, the water trapping member disposed at the end of the separator have a hole to pass the oxidant, supply of the oxidant will not be inhibited.

Accordingly, in this invention, since water produced at the air electrode is rapidly and effectively discharged while supply of the oxidant is fully secured, the

performance of the fuel cell can be maintained at high level without impairment.

Furthermore, in this invention, even when a plurality of separators is overlaid, extended adhered portions of the water trapping member, which are provided at the end face of each separator, contact to each other, so that the water can be effectively discharged.

[Embodiments]

Hereunder, embodiments of the invention will be described referring to the drawings.

As shown in Fig. 1(A), a separator [10] used in this invention, which works as paths of fuel and an oxidant and a power collection member, is disposed between a fuel electrode and an air electrode of a fuel cell, and normally has an oxidant feeding grooves [11] to pass an oxidant on a surface (upper side in the figure) that contacts with the air electrode and a fuel feeding grooves [12] on a surface (lower side in the figure)that contacts with the fuel electrode.

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As shown in Fig. 1(B), a water absorption layer [13] made of a hydrophilic material is provided in at least a part of the oxidant feeding grooves [11] provided on the separator of the above configuration so as to be along the

longitudinal direction of the grooves. The water absorption layer [13] may be provided at the bottoms [A] of the oxidant feeding grooves [11] or surfaces of the side walls [B], or may be provided in both.

The water absorption layer [13] that is used in this invention and is made of a hydrophilic material may be any as long as it absorbs water generated in the oxidant feeding grooves and convey to the ends of the grooves [11]. The water absorption layer [13] may include fiber structure such as knitted or woven fabric, filaments, or unwoven fabric, coating materials made of hydrophilic materials, or powder. Alternatively, the water absorption layer [13] may be a porous material, which is prepared by solidifying organic or inorganic particles with an adhesive material or by a sintering means. In addition, as the hydrophilic material, fluororesin, which is treated with hydrophilic treatment, may be also used.

As the above-described powder made of a hydrophilic material, for example, silicon carbide, and carbon black may be used.

In addition, in this invention, in order to more effectively discharge the produced water, as shown in Fig. 2, a water trapping member [15] may be provided on a side face [17] of an oxidant feeding manifold [30] of the

separator [10], where there are ends of the oxidant feeding grooves [11]. In addition, the water absorption layer [13] and the water trapping member [15] are connected to each other.

As a material for the water trapping member made of a hydrophilic material, for example, the same hydrophilic material as used in the water absorption may be used.

In this invention, the water trapping member [15] may be disposed on the face [17] of one separator.

In this case, it is preferred that the both edges of the water trapping member [15] do not cover an end of the oxidant feeding groove [11] and extend to a part of surfaces that face the fuel electrode and the air electrode of the separator respectively and adhered thereon. By doing this, when a plurality of separators is overlaid, the extended and adhered portions of each water trapping member, which are provided at the end of each separator, contact to each other, and water can be effectively discharged.

Fig. 2(A) is a perspective view of a fuel cell, in which a plurality of unit cells is overlaid. In each unit cell, the separator [10], fuel electrode [1], an electrolyte film [3], and an air electrode [2] are overlaid.

As obvious from Fig. 2(B), the water absorption layer [13] made of a hydrophilic material is provided on the

bottom part and the both side walls of the oxidant feeding grooves [11] provided on a surface that faces the air electrode [2] of the separator [10] as shown in Fig. 1(B). In addition, water trapping member [15] comprises a sheet or film structure made of a hydrophilic material is adhered on a side face [17] that faces the oxidant feeding manifold [30] of the separator [10]. Furthermore, the water trapping member [15] has through holes [21] at a portion that faces the oxidant feeding grooves so as not to bother the flow an oxidant in the oxidant feeding grooves [11].

Here, in this invention, a plurality of separators are supposed to be overlaid, and the water trapping member [15] is adhered or joined on the whole surface of the side face [17] of the separator on the oxidant feeding manifold side [30] in a fuel cell after overlaying the separators.

Furthermore, the water trapping member [15] is joined at the edges of the water absorption layer [13] and the oxidant feeding grooves, and water taken in the water absorption layer [13] is transferred to the water trapping member [15].

The lower edge of the water trapping member reaches the bottom part of the oxidant feeding manifold [30], and water collected by the water trapping member [15] is

discharged outside the system from the drain provided at the bottom part of the manifold.

Working principle of the embodiment is as follows.

More specifically, if the fuel cell is driven, water is produced at the air electrode because of the reaction.

The water becomes water drop in the grooves graved on the separator [10]. In this invention, since there is the water absorption layer [13] on a surface of the groove [11], the water is immediately absorbed, so that condensation of water to become large water drop and clogging of the grooves can be prevented.

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The water absorbed in the water absorption layer [13] is conveyed to the edge of the separator [10] by a capillary phenomenon.

Here, since the water absorption layer [13] contacts with the water trapping member [20], the water travels to the water trapping member [20] and moves downward by a capillary phenomenon and gravity, and then discharged outside from a drain [31].

Accordingly, in this embodiment, since the water produced at the air electrode immediately discharged without being retained in the oxidant feeding grooves, the

initial performance of the fuel cell can be maintained for long time without impairment.

Next, another embodiment of the invention will be described with Fig. 3. In Fig. 3, a mesh structure [23] essentially made of hydrophilic fiber is used in place of the sheet or film-like water trapping member of Fig. 2.

The mesh structure [23] may be a net-like or webbed mesh structure, or may be a lattice-like structure.

In this embodiment, the mesh pitch of the mesh structure is preferably set smaller than the width of the oxidant feeding groove [11], and the position of the water trapping member does not have to be precise and it is easy and inexpensive.

In addition, Fig. 4 shows yet another embodiment, and shows a cross-sectional view of a form of adhesion of the water trapping member to be adhered on the edge of the separator [10].

In this embodiment, a film structure [15] made of powder having hydrophilicity [24] made of carbon black or silicon carbide (SiC) is adhered on the edge [17] that faces the oxidant feeding means of the separator, while opening the ends of the oxidant feeding grooves. Furthermore, a part of upper and lower edges of the water trapping member is respectively extended, so as to reach

the edges [25] and [26] of respective faces that face the fuel electrode and the air electrode of the separator [10], and joined there [16] and [18]onto the edges [25] and [26].

The thicknesses of the joining sections [16] and [18] may be set such that the water trapping members stick to each other between the separators when separators are overlaid without making any space therebetween.

As described above, a fuel cell of the invention can be easily obtained by preparing several separators of the above configuration in advance, and then simply stacking the separators upon assembly of a fuel cell.

4. Brief Description of the Drawings

Fig. 1(A) is a perspective view of a separator used in this invention. Fig. 1(B) is the partial cross-sectional view.

Fig. 2(A) is a perspective view of an embodiment of the invention. Fig. 2(B) is the partial cross-sectional view.

Fig. 3 is a perspective view of another embodiment of the invention.

Fig. 4 is a perspective view of yet another embodiment of the invention.

2: Air electrode 10: Separator

12: Fuel feeding groove 13: Water absorption layer

15, 23: Water trapping member

17: End surface of a separator on the oxidant feeding manifold side

21: flow hole 31: drain

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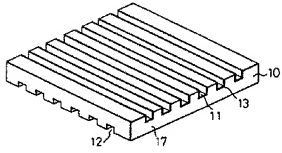

Fig. 1(A)

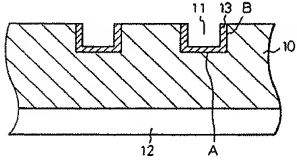

Fig. 1(B)

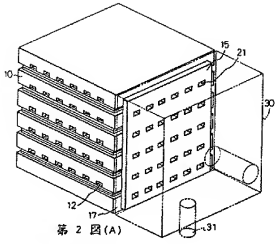

Fig. 2(A)

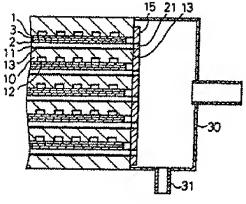

Fig. 2(B)

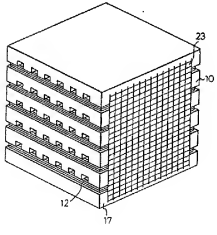

Fig. 3

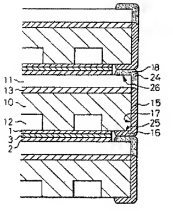

Fig. 4